MFSA FinSights | Enabling Technologies

Artificial Intelligence

The financial sector is continuously evolving through the rapid development and adoption of new technologies. The term 'FinTech' generally refers to financial innovation that seek to provide enhanced financial service offerings through the utilisation of enabling technologies. These generally include Distributed Ledger Technology & Smart Contracts; Artificial Intelligence, Machine Learning & Big Data, Cloud Computing, Web 3.0, Application Programme Interfaces and Micro-Services; Robotic Process Automation and the Internet of Things.

As part of the MFSA's initiatives to generate awareness, drive culture and deliver a cross-sectoral knowledge platform which can support the MFSA's functions in preparing for the financial services of tomorrow, these insights will delve into enabling technologies, enabling innovations and their sectoral applications.

1 What is AI?

Deploying computer software with a capacity to learn from experiences, essentially enables it to perform a myriad of complex tasks, such as image recognition, natural language processing, robotic process automation ('RPA'), risk management, fraud detection, credit scoring, amongst other. Artificial Intelligence ('AI') is the application of computerised tools that perform tasks which require human sophistication. Such computer systems may thus "*eventually replace the need for human engagement and oversight in entire processes or at least portions of processes*" (Smith, 2019).

1.1 Types of AI

Different types of AI systems are typically distinguished by assessing the degree of efficient human capability replication, having performance comparison and versatility as the key factors. Also, whereas some AI systems are examined and grouped on their emotive and thought comparability to humans, others are grouped based on their learning limitations and capabilities. Further to the above, some of the ordinary classifications of AI systems are as follows:

i. **Reactive Machines** – is the most basic AI type with no memory storage and no ability to learn. This system is restricted to a limited number of inputs, emulating human responses through their actions. IBM's chess-playing system 'Deep Blue' is an example of such AI type.

ii. **Limited Memory** – this AI type not only has the same capabilities as the reactive machines but also the ability to store knowledge and use it to learn and make decisions based on historical data. This is the most common type of AI that is implemented in self-driving cars, image recognition software and chatbots.

iii. **Artificial Narrow Intelligence (ANI)** – represents all programmable AI types that are used for performance of tasks with human-like capabilities which may include email spam filters, credit card fraud detection, amongst other. ANI do not exceed the predetermined boundaries of their code and thus have limited competencies.

iv. **Artificial General Intelligence (AGI)** – refers to the AI's ability to learn and perceive things in human like form. Also, the AGI's extensive capabilities to form connections independently reduces its learning cycle. Although to date there are no know examples of AGI, it is expected that AGI will be achieved soon.

VISIT…

Further to the above, some of the more advanced AI system that are still being explored include 'Theory of Mind' and 'Self-Awareness'. Whereas the former design in theory enables AI systems to understand and respond to human emotions, the latter represents the final stage of AI progress where technology will have a sense of self and human-level intelligence.

1.2 AI Algorithms

An algorithm "*may be defined as a set of steps to be performed or rules to be followed to solve a mathematical problem. More recently, the term has been adopted to refer to a process to be followed, often by a computer*" (FSB,2017). The purpose of such algorithms is thus to identify and automate solutions. AI algorithms can generally be based on three models, namely: *classification* (categorisation of new observations into groups); *regression* (identifying and describing a relationship between independent and dependant variables) and/or *clustering* (grouping together similar datapoints). There are a vast range of AI algorithms, some of which are outlined below:

i. **Linear Regression** – refers to regression type of an algorithm that formulates a prediction of one variable's value (the dependent variable) based on another variable's value (the independent variable). Hence, linear regression is useful for AI forecasting which can be applied in the evaluation of trend and sales estimates in the financial sector.

ii. **Logistic Regression** – is an algorithm that explores probabilities of events occurring based on independent variable data. It is a classification type of an algorithm that is used for predictive analytics, examining the probability of success or failure categorically (discrete variables), contrary to continuous variable prediction in the linear regression algorithm.

iii. **Decision Trees** – is a non-parametric supervised learning algorithm with hierarchal structurer with a base known as the root node that branches into decision nodes (internal nodes) and out into terminal nodes, that represent all possible outcomes. This algorithm is based on both classification and regression models and presents a transparent and digestible decision-making process for users however may not adjust well to new data.

iv. **K-Means Clustering** – this algorithm forms different clusters of unlabelled datasets based on the degree of similarity of datapoints. K represent a number of clusters that is defined by the user prior to executing the algorithm. This algorithm can be used in various domains ranging from customer segmentation in banks to document classification and cyber-profiling individuals.

Many other algorithms such as the Support Vector Machines, Deep Neural Networks and Naïve Bayes also fall within the vast range of AI algorithms presently used. As further outlined in the section below, depending on the categories and types of available datasets an appropriate machine learning technique should be selected to apply suitable AI algorithm.

1.3 Machine Learning and Big Data

In a broad sense, the term big data is used "*to describe the storage and analysis of large and/or complicated data sets using a variety of techniques* "(FSB, 2017). As a matter of fact, in the instances of automated prediction, optimisation or categorisation, Machine Learning ('ML') techniques are used for data analytics[1] as depicted in

[1] (FSB 2017, p. 4) 'Big data analytics' refers to the "*analysis of such large and complicated data sets*".

Figure 1 below. ML refers to the development of algorithms designed to 'learn' and evolve while solving complex assignments with little to no human intervention. The ML techniques are categorised according to the level of human interaction, as follows:

i. **Supervised Learning** – 'Training' data containing some labelling is fed into an algorithm in order to 'teach' the algorithm to, for example, distinguish between fraudulent and regular transactions. As a result, the algorithm will 'learn' to classify the transactions accordingly and will be able to predict fraudulent transactions in the data set provided.

ii. **Unsupervised Learning** – Data provided in this mode of learning is unlabelled, therefore the algorithm is directed to identify patterns within the data set and associate data observations into clusters. This type of unsupervised machine learning algorithm could be applied to determine the price of illiquid securities, whereby the algorithm would look for securities that have characteristics similar to an illiquid security. Once an appropriate cluster of securities is identified it can be then used to price the illiquid securities.

iii. **Reinforcement Learning** – The algorithm in this case is fed unlabelled data and is provided with feedback to facilitate the learning process.

iv. **Deep Learning** – This form of ML is a specific type of 'Artificial Neural Networks' where the composition of the model consists of a large number of layers that work similarly to human brain function. This algorithm can also be applied for supervised, unsupervised and reinforcement learning.

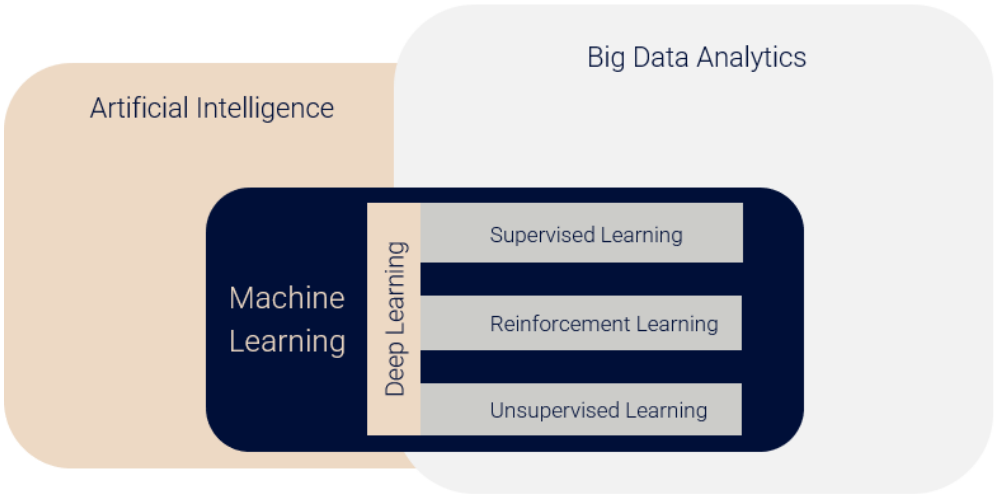

FIGURE 1: Schematic Structure of AI, ML and Big Data Analytics
Source: FSB (2017)

1.4 EU's Artificial Intelligence Act

The development of AI systems results in its adoption into entire spectrum of industries ranging from environment public sector and health to financial services and agriculture. For such adoption to occur, a certain degree of harmonisation between law and technology must be reached. In this respect a European Union ('EU') legal framework namely, the Artificial Intelligence Act was laid down for the development, marketing and use of AI in conformity with EU values. The proposed AI Act seeks to achieve several objectives such as legal certainty and ensuring that AI systems within the EU market are safe as well as respect existing EU laws. The regulation essentially strives to achieve a balanced approach to AI systems and tools that would address the risks posed by the technology without unduly constraining technological development.

2 Benefits and Risks

AI is a fast-evolving new technology that has the potential to contribute to an array of economic and societal benefits across the entire spectrum of industries. However, certain specific application and use cases of AI technology may generate new risks that can harm public interest. Below is a non-exhaustive list of risks and benefits presented by the AI systems.

BENEFITS

Productivity – AI solutions reduce the time and increase efficiency of information processing and execution of repetitive tasks.

Decision-Making – AI solutions help improve user's decision-making when interacting with systems via augmented intelligence. It also reduces subjectivity and other biases.

Risk Management – AI can be used in back-testing analysis of risk models and their performance with respect to different systems and processed in various sectors. For example, some trading platform may rely on specific AI techniques to manage trading risk exposure of open positions.

Cost Reduction – Application of AI tools such as RPA can significantly reduce costs associated with mundane and repetitive tasks.

High Accuracy – Similar to other types of software, AI system generally perform critical tasks or solve complex equations with higher accuracy as compared their human counterparts

Financial Inclusivity – AI tools may assist entrepreneurs and start-ups in securing the necessary funds for their project by means of AI based advanced credit scoring systems.

RISKS

Accountability – Accountability is a key issue and risk area in AI due to a general lack of safe accountability mechanisms if vulnerabilities are exploited.

Black Box Algorithms and Lack of Transparency – Some algorithms of AI systems may become so inordinately complex that explaining how the results were generated will be virtually impossible. In fact, AI models with little degree of certainty of how they operate, and make decisions, are referred to as 'black box' models.

Data Quality – The accuracy of results generated by an AI tool is directly related to the quality of data that is processed by the algorithm.

Competition – Costs and investment surrounding AI systems may have a negative impact on SMEs competitiveness and as a result increasing dependency on larger corporations and harbouring greater risks of collusion.

Regulation – The increasing development of AI could lead to some potential inconsistencies with existing regulatory frameworks as well as general risk of policy fragmentation, that prevent cross-border application of AI techniques.

Discrimination – AI techniques may have unintended biases that discriminate a class of people, and thus may pose a risk of human right violation.

Supplementary Reads…

Financial Stability Board (FSB) (2017), Artificial Intelligence and Machine Learning in Financial Services. Available online.

Organisation for Economic Co-operation and Development (OECD) (2021), Artificial Intelligence, Machine Learning and Big Data in Finance. Available online.

Proposal for a Regulation 2021/0106 (COD) of the European Parliament and Council of 21 April 2021 laying down harmonised rules on artificial intelligence (Artificial Intelligence Act) and amending certain Union Legislative Acts. Available online.

Girasa (2020), Artificial Intelligence as a Disruptive Technology. Economic Transformation and Government Regulation. Available online.

Forbes (2019), 7 Types of Artificial Intelligence. Available online.

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